

Deer Fibroma: A Review

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SUMMARY

Fibromas are frequent cutaneous neoplasms of young deer of many species, characterized by proliferation of both epithelial and dermal cells. Virus particles, similar to those found in fibrous skin tumors of several wild and domestic species, have been identified in some species by electron microscopy. Attempted transmission of fibromas has not been uniformly successful using filtered preparations.

RÉSUMÉ

Une revue des fibromes cutanés des cervidés

Les fibromes représentent des néoplasmes cutanés fréquents, chez les jeunes sujets de plusieurs espèces de cervidés; ces tumeurs se caractérisent par la prolifération des cellules épithéliales et dermiques. La microscopie électronique a permis d'identifier, chez certaines espèces, des particules virales semblables à celles que recèlent les tumeurs cutanées fibreuses de plusieurs espèces sauvages et domestiques. Les essais de transmission de ces fibromes, à l'aide de filtrats, n'ont pas toujours été couronnés de succès.

INTRODUCTION

Fibromas are the most frequent cutaneous neoplasm reported from Cervidae. They have been diagnosed as fibroma, ossifying fibroma, fibrosarcoma, multiple neurofibromatosis, fibropapilloma, papilloma, and warts (Table I). Most authors are of the opinion that virtually all fibromatous skin tumors of deer are fibromas (6, 16, 49, 52).

Fibromas have been reported in white-tailed deer (*Odocoileus virginianus*), mule deer (*Odocoileus hemionus*), black-tailed deer (*Odocoileus hemionus*), fallow deer (*Cervus*

dama), red deer (*Cervus elaphus*), roe deer (*Capreolus capreolus*), Sika deer (*Cervus nippon*), moose (*Alces alces*) and caribou (*Rangifer caribou*) (Table I).

Prevalence

During the 1962 deer season in New York State, 1.4% of over 3000 deer examined had skin tumors, similar grossly to fibromas (19). Another

study in New York State found the prevalence to be less than 1% (49). Postmortem examination of 236 deer at the University of Maine from 1946 to 1958 revealed 13 (5.5%) skin tumors (2). A study in Michigan from 1933 to 1962 found 11 (1.3%) fibromas in 861 deers examined (15). Necropsies of 74 diseased deer in South Dakota exposed four (5.4%) cases of multiple fibromas (44). Tumors of all types

TABLE I
SKIN TUMORS REPORTED IN MEMBERS OF THE FAMILY CERVIDAE

Location		Reference(s)
<i>White-tailed Deer</i>		
Kentucky	Fibroma	15, 23
Maine	Skin tumors	2
Maryland	Fibrosarcoma	14
Michigan	Fibroma	15
New Hampshire	Neurofibroma, fibroma	3, 26
New Jersey	Infectious cutaneous fibroma, ossifying fibroma	47, 51, 52
New York	Papilloma, cutaneous fibroma	19, 49
North Carolina	Fibromous tumor	48
North Dakota	Warts	46
Ontario, Canada	Papillomatosis and fibromatosis	20
Pennsylvania	Papilloma or fibroma	18, 33
South Dakota	Multiple fibromas	44
Vermont	Fibrosarcoma	56
Virginia	Fibroma	15, 43
Wisconsin	Fibroma, epithelial papilloma, papilloma and fibroma	8, 12, 31, 32, 54
<i>Mule Deer and Black-tailed Deer</i>		
Arizona	Papilloma and fibroma	53
British Columbia	Papilloma or fibroma	10
California	Papilloma; warts	22, 36, 37
North Dakota	Warts	46
Washington	Papilloma	7
Wyoming	Papilloma, fibroma	24, 25
<i>Other Cervidae</i>		
Alaska	Warts (Sika deer)	11
British Columbia	Contagious warts (Moose)	40
Germany	Papillomatosis (Fallow deer)	21
Great Britain	Multiple papillomas (Red deer)	27
Michigan	Warts (Moose)	39
Canada: Northwest Territories	Fibropapilloma (Caribou)	6
Ontario	Papillomatosis and fibromatosis (Moose)	48
Scotland	Fibroma (Red deer)	38
Sweden	Fibroma (Roe deer, Moose)	4, 5

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were diagnosed in roughly 1% of the carcasses examined (27/2827) in Sweden from 1948 to 1969 (4). From the figures above, the prevalence among randomly sampled, free-living deer appears to be about 1%. Increased frequency of fibroma diagnosis is associated with selection of diseased animals for examination.

Age

Fibromas occur most frequently in animals under two years of age (6, 7, 36, 46, 49). Occasional cases are reported in adult and aged animals (47, 49, 52). A malignant skin tumor, grossly resembling a fibroma has been diagnosed in an aged white-tailed deer (14). In a survey in New York State of over 3000 white-tailed deer, fibromas were most frequent in animals from 1.5 to 2.5 years of age (19).

Sex

The 1962 New York survey found a high prevalence of fibromas among male white-tailed deer (19). The tumor was diagnosed in 2.1% of the males and 0.4% of the females. This may have been caused by differences in possible exposure to a transmissible agent, to abrasions occurring during the fighting of males during the rut, or to rubbing of antlers to shed velvet. More bucks are shot (either by law or hunter preference) which influences the sampling.

Gross Morphology

Deer fibromas are most often observed as firm, round, nodular skin tumors up to 1 cm in diameter (16, 46, 51) (Figures 1 and 2). They have been reported to range in number from 1 to 226 (26) and in size from 0.5 to 25 cm (47, 51). The tumors are often dark brown to black, with a smooth or wrinkled surface. Unpigmented, tan to white, fibromas are occasionally observed, usually in areas of the body where the hair is white. Large fibromas have either a smooth or verrucose surface; they may be ulcerated and are often pedunculated. They are not locally invasive and can be readily removed surgically. The cut surface is firm, white, and covered by thickened pigmented epidermis (16, 25, 31, 46, 47, 51).

Ossifying fibromas are rare. One case had a 1 cm thick outer cortex that

resembled a typical fibroma whereas the center was ossified, making sectioning with a knife impossible (47).

A white-tailed deer with cutaneous fibromatosis was found to have many discrete, firm, white nodules protruding from the surface and deep in the parenchyma of the lung. These were considered to be metastases from cutaneous fibromas based on histological examination (31), but may have represented multiple hits by the causative agent. The latter has been observed naturally and experimentally reproduced (28, 29, 30, 50) in the squirrel fibroma caused by a poxvirus. Pulmonary lesions have been found in moose with cutaneous fibromas (5).



FIGURE 1. Fibromas are frequently found as firm, round, black to tan tumors, involving the skin around the eyes (white-tailed deer).



FIGURE 2. White-tailed deer with fibroma. A solitary tumor is present on the dorsal side over the lumbosacral region.

Malignant skin neoplasms have been observed rarely in old deer, but may resemble fibromas. They tend to be locally invasive and firmly attached to the underlying connective tissue (14), and some malignancies may interfere with antler development (41).

Deer fibromas may be found anywhere on the body but are most prevalent around the eyes, mouth, neck, and medial aspect of the forelimbs (24, 39, 43, 53, 56).

Microscopic Morphology

The connective tissue portion of the fibroma consists of stellate, angulated, or spindle-shaped fibroblasts producing a matrix of swirling collagen strands, which tend to be arranged perpendicular to the epithelial layer, extend parallel to each other into the tumor, and become randomly arranged deep within the mass. There is a marked difference between the densely packed fibroma and the more loosely arranged connective tissue of the dermis. The fibroma is not encapsulated and mitotic figures are not seen (16, 31, 52). Adnexal structures may be present in the mass and are usually widely separated (31).

Changes in the epidermis vary among fibromas. The thickened epidermis may be acanthotic or may have long rete pegs extending into the underlying fibromatous tissue. The basal cells may contain varying amounts of melanin, corresponding to the color observed grossly. Slightly eosinophilic, homogeneous intranuclear inclusions have been reported in the outermost layer of the stratum granulosum and the parakeratotic areas of the stratum corneum, but they are not consistent findings (54).

Two cases of fibrosarcoma have been reported. In one case the gross photographs resembled multiple fibromas. The brief histological description was suggestive of a fibroma except there were mitoses (56). In the second case, in which there was extensive osseous infiltration of the supraorbital process, the tumor consisted of fusiform or stellate cells with many larger plump cells with pale ovoid nuclei. Occasional multinucleated cells were present. Mitotic figures were infrequent (14).

Electron Microscopy

Viral particles have been observed in the nuclei of cells in the upper stratum granulosum and in the stratum corneum of white-tailed deer and mule deer fibromas (unpublished data; 54). The number of virus particles per nucleus varied, with smaller numbers present deep in the stratum granulosum. The viral particles were occasionally observed in close relationship to chromatin associated with the nucleolus or with the periphery of the nucleus. In the parakeratotic region, the nucleus was largely replaced by masses of packed particles corresponding to the intranuclear inclusions observed with the light microscope. In parakeratotic cells the nuclear membrane may be unrecognizable and viral particles may be present in the cytoplasm of intracellular spaces (54).

Negatively stained preparations from both white-tailed and mule deer fibromas contain viral particles with a circular outline (Figure 3). Full and empty capsids can be distinguished. The surface of the full capsid is composed of capsomeres about 7 m μ in diameter, with an axial hole approximately 2.5 nm in diameter. The virus particles observed measured 53 m μ with a full capsid and 50 m μ when empty in negatively stained preparations. Individual particles in thin sec-

tions measured 34 m μ with a center to center distance of 36 m μ . These findings suggest that the virus belongs to the papova group (54).

Virus particles were observed in a suspension of the epithelial portion of the cutaneous fibromas in a white-tailed deer with pulmonary lesions (31). Particles were not observed with an invasive fibrosarcoma or its overlying epithelium when examined by electron microscopy (14).

Etiology and Transmission

The etiology of the deer fibroma was thought to be of viral nature long before any reported transmission studies, based on morphological and epidemiological similarities to tumors in other species that had been transmitted by a filterable agent (22, 24). Shope *et al* (51, 52) successfully transmitted deer fibroma by inoculating preparations filtered through Berkefeld N filters onto scarified skin of captive white-tailed deer. Tumor development was first observed seven weeks following inoculation. Most of the tumors regressed two months after development. Tumors produced were identical histologically to those of naturally affected animals. Attempts to transmit fibromas to deer by other researchers have been unsuccessful (25).

Attempts to transmit white-tailed deer fibromas to rabbits, guinea pigs, sheep, calves, monkeys and horses have been unsuccessful (32, 52). Neoplasms developed in hamsters after seven months when fibroma suspensions were inoculated subcutaneously (32). Lung metastases occurred in 10% of hamsters with induced subcutaneous fibromas (31).

Similarities between bovine papillomatosis and deer fibroma have suggested a common or similar etiology. Attempts to induce fibromas by application of bovine papilloma virus to scarified skin or by intradermal injection in white-tailed deer have been unsuccessful (52).

Successful transmission attempts, epidemiology and the observation of virus particles strongly suggest a viral etiology. The mode of natural transmission is unknown. Large fibromas are often ulcerated which may be due to abrasion. Certain trails tend to be

well used by deer and, as such, unaffected animals may be inoculated through contact with objects along the trail. Blood feeding insects may be important vectors (15, 16). The virus may be transmitted by contaminated equipment as has been reported with bovine papilloma, or by exposure of a wound to environmental sources (1, 17, 42, 55). An ossifying fibroma developed at an ear-tagging site (47).

Growth, Metastasis and Immunity

Large ulcerated fibromas are infrequently observed. Naturally occurring fibromas may develop to a certain point and then regress, as has been demonstrated with experimentally induced cases (52). Naturally occurring cases of regression in marked animals have been observed (36). Fibromas that continue to increase in size may result in visual obstruction if near the eye or interfere with prehension when present around the mouth (7, 11, 37, 44, 49, 53). Metastasis or local invasion are not usually associated with fibromas. Metastases to visceral organs have been reported infrequently (5, 31) and may represent multiple hits by the causative agent rather than true metastases.

Using a suspension of bovine papilloma virus, precipitin antibodies have been demonstrated in sera from calves with either experimentally induced or natural cases of papillomatosis. Precipitin lines did not develop when these sera were tested against antigen prepared from a white-tailed deer fibroma (35).

Persistent papillomatosis in cattle (13) and man (9, 34, 45) has been associated with a deficiency of cell mediated immunity, but not of the humoral immune response. A similar mechanism may be involved with rare cases in deer in which the animal has large numbers of these cutaneous tumors.

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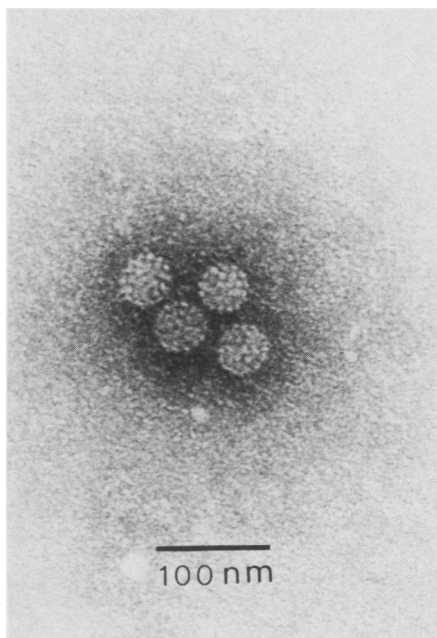


FIGURE 3. Virus-like particles from a negatively stained white-tailed deer fibroma (epidermal homogenate). X147 000.

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